

Description of the larva of *Somatochlora margarita* (Odonata: Corduliidae)

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ABSTRACT

The larva of *Somatochlora margarita* is described from a specimen reared from the egg to the final stadium. The larva, previously unknown, is morphologically similar to the larvae of *S. calverti*, *S. filosa*, *S. ozarkensis*, and *S. provocans*. Combinations of diagnostic characters are given for distinguishing these species. Growth of this species is discussed with respect to other species of *Somatochlora* and Odonata.

INTRODUCTION

Somatochlora margarita Donnelly has arguably the most restricted distribution of all the North American *Somatochlora*. It is known from the long-leaf and loblolly pine forests of southeast Texas and northern Louisiana. For nearly 30 years this species was only known from its type locality in the Sam Houston National Forest (San Jacinto Co., Texas), but Price et al. (1989) expanded its initial range to a now estimated 16,000 km² area in east Texas. It has also now been found in northern Louisiana (Abbott 2001, 2005). Adults can be locally abundant, but are generally not well represented in collections. The larva has remained undescribed until now. The terminal stadium is described here from a larva reared from eggs collected from a gravid female. The female was collected northwest of Shepherd in San Jacinto Co., Texas. To our knowledge, the larva has not been collected in the wild to date.

The larval stage of 24 of the 26 known species of *Somatochlora* occurring in North America has been described (Cashatt & Vogt 2001; Steffens & Smith 2006). The two remaining species are *S. calverti* Williamson & Gloyd and *S. margarita*. The primary author is in possession of the larvae of *S. calverti* and is preparing a formal description. We present preliminary characteristics of that species and describe the larva of *S. margarita* comparing it to other known *Somatochlora* larvae in this paper. All exuviae associated with the reared final stadia were examined. Notes on the growth of this species and early stadia are also included.

MATERIAL AND METHODS

The description is based on one final stadium female larva reared from egg to final stadium by S.W. Dunkle. Eggs were collected from a female, 23 June 1985, by S.W. Dunkle, USA, Texas, San Jacinto Co., NW of Shepherd in Sam Houston National Forest (Fig. 1). Eggs hatched 30 September 1985.

All larvae were preserved in 80% ethanol. Dimensions are given to the nearest 0.1 mm and were made with an ocular micrometer. We did not examine all of the exuviae obtained from early stadia of *S. margarita*, nor did we quantify most characters for these stages. In some cases the exuviae were destroyed by the prey items in the vials with the larvae or by the larvae themselves. The final stadium female is shown in Figure 2.

All material referred to in this description is deposited in the Brackenridge Field Laboratory Insect Collection at the University of Texas at Austin.

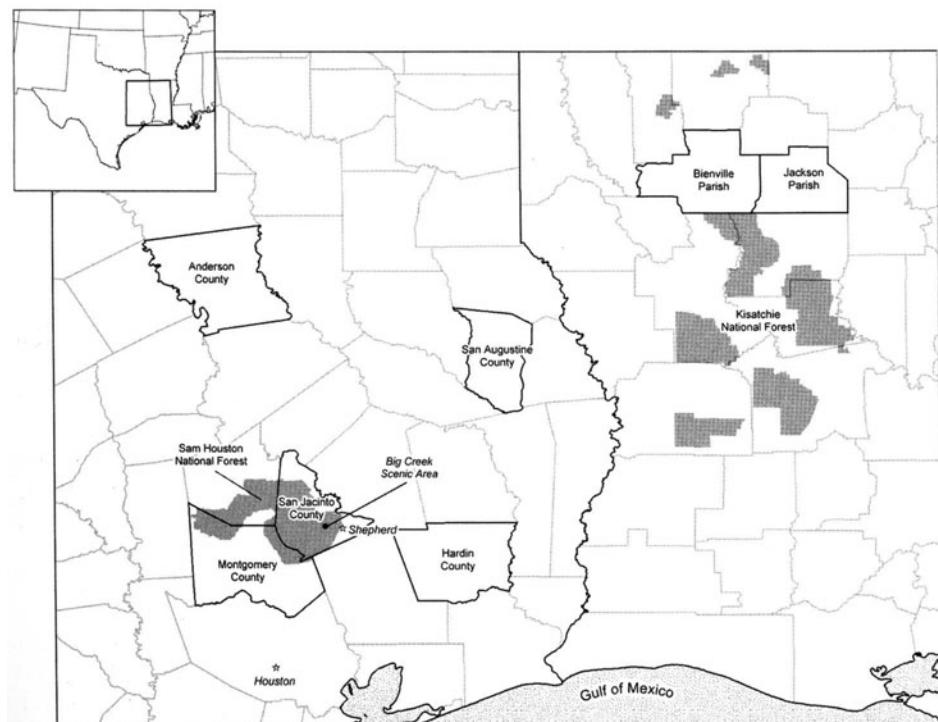


Figure 1: Distribution of *Somatochlora margarita* — showing seven counties in Texas and Louisiana where this species has been reported.

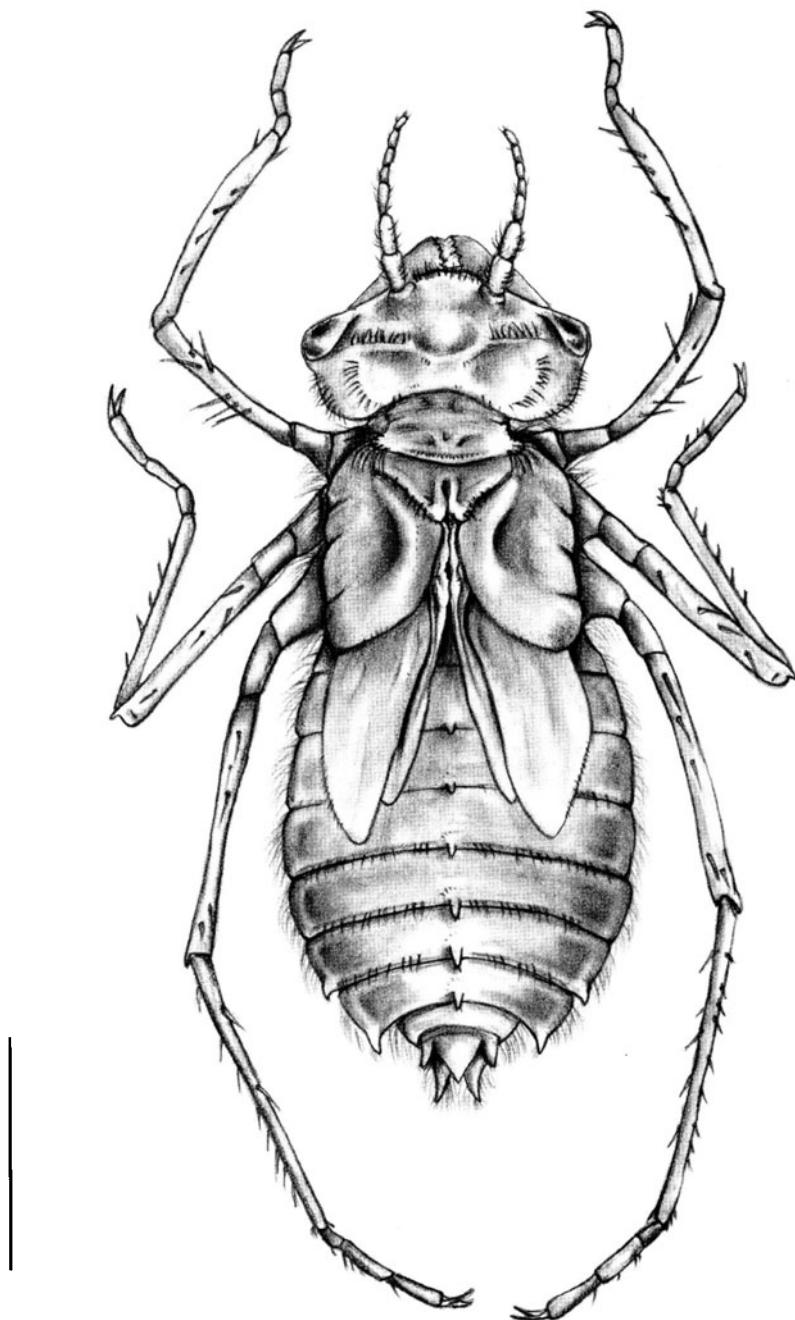


Figure 2: *Somatochlora margarita* larva — dorsal view; scale line 5 mm.

LARVAL DESCRIPTION

The larva of *S. margarita* is elongate with a total length of 19 mm, moderately covered with hairs, and generally pale in coloration (Fig. 2). The head is twice as wide as long with small eyes that are slightly elevated. The abdomen is oval and slightly wider than the head. *S. margarita* appears most similar to *S. provocans*.

Head: Width 6.0, widest at eyes; about twice middorsal length 3.1. Lateral margins behind eyes broadly convex, converging posteriorly at concave occiput. Frons and occiput with dense, coarse setae. Antennae 5.2 in length. Segments 1-7 with lengths of 1.0, 0.9, 0.9, 0.5, 0.5, 0.7, and 0.6 respectively. Segments uniformly colored pale throughout, with segments 1 and 2 densely clothed with coarse setae. Segments 3-7 sparsely clothed with fine setae. Labium pale extending posteriorly to level of mesocoxae. Prementum 4.8 at greatest width; anterior margin angulate with edge slightly concave. Palps triangulate with 8 crenulations each bearing a cluster of 5-8 spiniform setae of varying lengths; dorsal setae numbering 3-4 twice as long as ventral setae. Lateral margin clothed with fine, dense setae. Palpal setae 9 with 18-20 fine spicules posterolaterally. Premental setae numbers 11 (Fig. 3).

Thorax: Widens posteriorly, not quite reaching width of head (ratio 3:2.8). Prothorax with dorsolateral protuberances and margins of prothorax bearing short, coarse setae. Lateral margins proximate to procoxae bearing long, fine setae; pterothorax with dorsal ridges and short, coarse setae medially. Lateral margins bearing long,

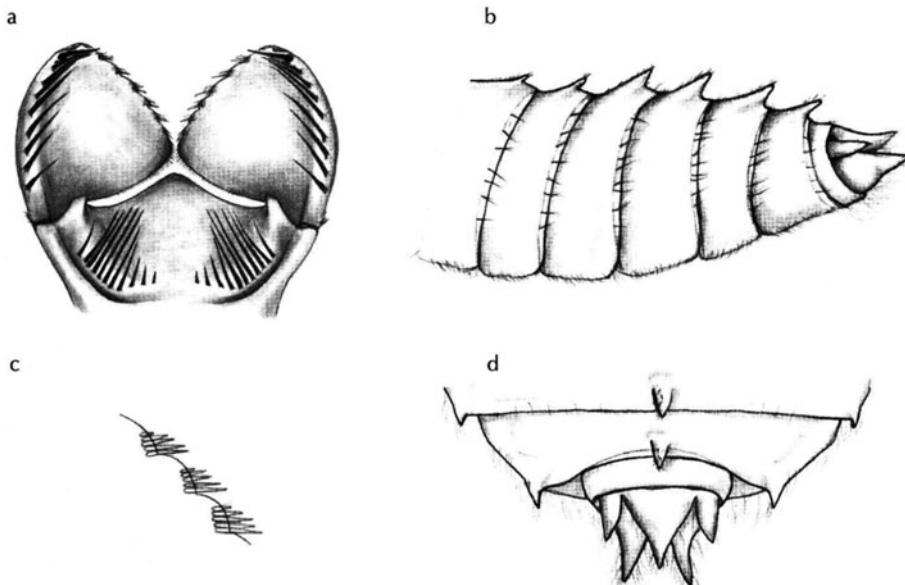


Figure 3: *Somatochlora margarita* larva — (a) prementum showing lateral and premental setae, dorsal view; (b) abdomen, lateral view; (c) closeup of left labial palp showing crenulation and associated setae; (d) terminal appendages, dorsal view.

Table 1. Characters of larval stadia 2-13 in *Somatochlora margarita*. — Total: total length; TheoL: theoretical length, obtained by dividing the total length of stadium 13, 19 mm, successively by 1.26; PalpS: palpal setae; PremS: premental setae; Wings: number of abdominal segments the hindwing sheath extends, + indicates presence of wing sheaths, - indicates absence.

Stadium	n	Total [mm]	TheoL [mm]	PalpS	PremS	Wings
2	12	1.2-1.5	1.5	0	1	-
3	5	1.9-2.3	1.9	1-2	2-3	-
4	6	2.5-3.1	2.4	2-3	3-5	-
5	7	3.2-3.8	3.0	2-3	4-5	-
6	5	4.0-4.6	3.8	3-4	5-6	+
7	7	5.2-6.2	4.7	4-5	6-8	+
8	5	6.6-7.4	6.0	4-5	8-9	1-2
9	6	8.0-8.8	7.5	5-6	8-9	2
10	2	9.1-9.2	9.5	6	9-10	2-3
11	1	10.8	12	7	10	3
12	1	16.9	15.1	8	11	4
13	1	19	19	9	11	6

fine setae; longest at anterior and posterior margins. Prosternum bearing short, stout setae on anterolateral protuberances. Mesosternum larger than metasternum; both with well-developed anterolateral protuberances bearing long setae. Legs uniformly tan; coxae and trochanters densely clothed with short setae. Length of metafemur 6.5; length of metatibia 6.5. Hw sheath 6.3 long, extending just past anterior edge of S6.

Abdomen: Oval in general shape, widest at S5-7. Length measured along the ventral midline including the terminal appendages, 11.4; maximum width in ventral view 7.7. Dorsum glabrous except for posterior margin of each tergite armed with a row of 7-12 short, coarse setae, centered each side of the midline. Lateral margins with dense setae becoming long and hair-like on S8-10; setae on S9 and S10 extending past paraprocts for a distance equal to length of paraprocts. Venter of abdomen glabrous. Middorsal hooks acute and falciform occurring on S4-9 (Fig. 3). A vestigial hook may be present on S3. Largest middorsal hooks on S7 and S8. Middorsal hook on S9 extends just short of the midpoint of S10. Lateral spines on S8 and S9; apices directed posteriorly. Lateral margins with short, dense setae; those on S8 approximately half the length of S9. Spines on S8 0.6 length of those on S9 and 0.2 length of margin of S8 (anterolateral to posterolateral corners of sternite). Spines on S9 0.3 length of margin of S9 (anterolateral to posterolateral corners of sternite). Epiproct acuminate extending well beyond distal ends of cerci; lateral margins distinctly concave; length 1.3.

DISCUSSION

Among North American *Somatochlora* species, the presence of prominent middorsal hooks on the middle abdominal segments separates *S. margarita* from the 12 species that lack these hooks. Four of the 14 species that have middorsal hooks (see Cashatt & Vogt 2001), *S. calverti*, *S. filosa*, *S. ozarkensis* Bird, and *S. provocans* Calvert, are most similar to *S. margarita* (Table 2). Of these four species, *S. margarita* can be distinguished from *S. calverti* and *S. filosa* by the shorter and broader lateral spines on S9. In *S. calverti* and *S. filosa* these spines are twice or more long as wide. The two remaining species, *S. ozarkensis* and *S. provocans* each have 7-8 palpal setae while *S. margarita* has 9.

Larvae of many species of *Somatochlora* are often hard to collect due to their restricted habitats (Cashatt & Vogt 2001). Several species including *S. ensigera* Martin (Huggins 1983) and *S. filosa* (Dunkle 1977) have been described based on reared final stadium larvae and in some cases exuviae. Cashatt & Vogt (2001) provided a key to all known North American *Somatochlora* larvae. In this key *S. margarita* keys out to couplet 9 and *S. provocans*. The following emendation to the key will separate *margarita* from *provocans*.

9a Middorsal hooks of S7-9 with posterior margin curved in lateral view 10
9b Middorsal hooks of S7-9 with posterior margin straight in lateral view ... 28

28a Palpal setae 7-8; head width 6.3-6.4 *provocans*
28b Palpal setae 9; head width < 6.2 *margarita*

Larval growth

We interpret the interlarval exuviae in hand and growth of *S. margarita* to mean that it has 13 larval stadia including the prolarva. This is within the range (12-14) of other reared *Somatochlora* (Münchberg 1932; Miyakawa 1971; Dunkle 1977; Sternberg 1990). Data are presented for total length, palpal setae, premental setae, and extent of wing sheaths in Table 1. The average growth rate between larval stadia based on total length was 1.28. This is the same as that calculated by Miyakawa (1971) for *S. viridiaenea* Uhler, is close to 1.27 found by Dunkle (1977) for *S. filosa* (Hagen), and falls well within the known growth rates for Odonata, 1.25-1.29 (Calvert 1929, 1934; Bick 1951). This rate is also close to the theoretical growth rate (Przibram-Megusar factor) of 1.26 discussed by Bick (1951).

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Table 2. Diagnostic characters of four *Somatochlora* larvae similar to *S. margarita*; measurements in mm.

Character	<i>calverti</i> ¹	<i>filosa</i> ²	<i>margarita</i>	<i>ozarkensis</i> ³	<i>provocans</i> ⁴
S9 spines at least 3/5 wide as long	-	-	+	+	+
Middorsal hooks	5-9	4-9	4-9	4-9	4-9
# of crenulation setae	6-8	6-7	5-8	5-6	5-8
# of palpal setae	7	9	9	7-8	7-8
# of premental setae	10	12-13	11	12-13	11-12
Total length	21	19-22	19	23	22-25.5
Head width	5.7	6.2-6.7	6	6	6.3-6.4
Metatibia length	5.8	7.6-8.3	6.5	8	7.7-8.2
Head width : metatibia length ratio	1.02:1.0	1.1-1.4	1.0:1.08	1.0:1.3	1.0:1.3
Hind femur	6.2	6.6-7.0	6.5	7	6.6-7.35

¹ Unpublished data; ² data taken from Dunkle (1977); ³ data taken from Pritchard (1936); ⁴ data taken from Tennesen (1975)

REFERENCES

Abbott, J.C., 2001. Distribution of dragonflies and damselflies (Odonata) in Texas. *Transactions of the American Entomological Society* 127: 189-228.

Abbott, J.C., 2005. Dragonflies and damselflies of Texas and the south-central United States: Texas, Louisiana, Arkansas, Oklahoma, and New Mexico. Princeton University Press, Princeton.

Bick, G.H., 1951. The early nymphal stages of *Tramea lacerata* Hagen (Odonata: Libellulidae). *Entomological News* 52: 293-303.

Cashatt, E.D. & T.E. Vogt, 2001. Description of the larva of *Somatochlora hineana* with a key to the larvae of the North American species of *Somatochlora* (Odonata: Corduliidae). *International Journal of Odonatology* 4: 93-105.

Calvert, P.P., 1929. Different rates of growth among animals with special reference to the Odonata. *Proceedings of the American Philosophical Society* 68: 227-274.

Calvert, P.P., 1934. The rates of growth, larval development and seasonal distribution of dragonflies of the genus *Anax*. *Proceedings of the American Philosophical Society* 73: 1-70.

Dunkle, S.W., 1977. The larva of *Somatochlora filosa* (Odonata: Corduliidae). *Florida Entomologist* 60: 187-191.

Huggins, D.G., 1983. The nymph of *Somatochlora ensigera* (Odonata: Corduliidae). *Journal of the Kansas Entomological Society* 56: 415-419.

Price, A.H., R.L. Orr, R. Honig, M. Vidrine & S.L. Orzell, 1989. Status survey for the big thicket emerald dragonfly (*Somatochlora margarita*). United States Fish and Wildlife Service Cooperative Agreement No. 14-16-0002-86-925, Amendment No. 7, pp. 1-17.

Miyakawa, K., 1971. Life-history of *Somatochlora viridiaenea viridiaenea* Uhler with notes of nymphs of *S. v. atrovirens* Selys (Odonata, Corduliidae). Bulletin of the Sugadaira Biological Laboratory of Tokyo Kyoiku University 4: 31-46.

Münchberg, P., 1932. Beiträge zur Kenntnis der Biologie der Libellenunterfamilie der Cordulinae Selys. Internationale Revue der Gesamten Hydrobiologie und Hydrographie 27: 265-302.

Pritchard, A.E., 1936. Notes on *Somatochlora ozarkensis* Bird (Odonata, Libellulidae, Corduliinae). Entomological News 47: 99-101.

Steffens, W.P. & W.A. Smith, 2006. Description of the larva of *Somatochlora incurvata* Walker (Anisoptera: Corduliidae). Odonatologica 35: 379-383.

Sternberg, K., 1990. Autökologie von sechs Libellenarten der Moore und Hochmoore des Schwarzwaldes und Ursachen ihrer Moorbindung. Ph.D. Thesis, Universität Freiburg.

Tennessee, K.J., 1975. Description of the nymph of *Somatochlora provocans* Calvert (Odonata: Corduliidae). Florida Entomologist 58: 105-110.